



# BIO-BASED MATERIALS IN CANADIAN CONSTRUCTION

White Paper to Advance Industry Understanding and Uptake

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# ACKNOWLEDGMENTS

**AUTHORS**  
Michael Mousa, DIALOG  
Anushka Karmalkar, DIALOG  
Charles Marshall, DIALOG  
David Messer, Climate Smart Building Alliance

**INTERVIEWS & INDUSTRY INPUT**  
Brandon Cochran, HempWorks Canada  
Breanne Belitski, Builders for Climate Action  
Gaetan Dujardin, IsoHemp  
Garrett Johnson, Hundred Year Materials  
Jack Keays, Vortex Fire Consulting Inc.  
Katie Theall, DIALOG  
Melanie Bonang, Mattamy Homes  
Mohammad Haque, Mattamy Homes  
Samuel Kondratski, Savick  
Tyler Bennett, Stelumar Advanced Manufacturing Inc.

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# EXECUTIVE SUMMARY

Embodied carbon emissions of buildings represent a critical opportunity for the construction sector to deliver on immediate climate action. Bio-based materials, those derived wholly or partially from renewable biological resources, offer an impactful pathway to both reduce embodied emissions, while also storing biogenic carbon in building assets. When sustainably sourced and paired with responsible end-of-life strategies, bio-based materials can deliver meaningful climate benefits alongside broader economic, environmental, and social value.

This white paper was developed to support the Climate Smart Buildings Alliance (CSBA) in advancing industry understanding and uptake of carbon-storing and bio-based materials in Canada’s built environment. We have focused on applications with high impact potential in larger residential, institutional, and commercial buildings, prioritizing building envelope systems and select interior applications. Mass timber structural systems, whose application in these building types has accelerated in recent years and are frequently referenced, are not a primary focus of this study.

The findings draw on targeted stakeholder interviews with practitioners involved in the development, specification, and delivery of bio-based materials in Canada, combined with research of best practices and case studies from other regions internationally.

The report identifies three high-potential bio-based materials for near- to medium-term scale-up in Canada, considered factors including carbon and environmental performance, code and risk readiness, technical performance, constructability, and supply chain scalability. These include **wood** based products, engineered and prefabricated **straw** based systems, and **hemp** based materials. These materials demonstrate strong carbon reduction potential, increasing technical maturity, and alignment with Canadian forestry and agricultural sectors.

A set of emerging materials are also profiled as longer-term opportunities that warrant continued innovation and market development, but face greater near-term constraints in Canada. These include bamboo, cork, biochar, mycelium, flax, and rammed earth.

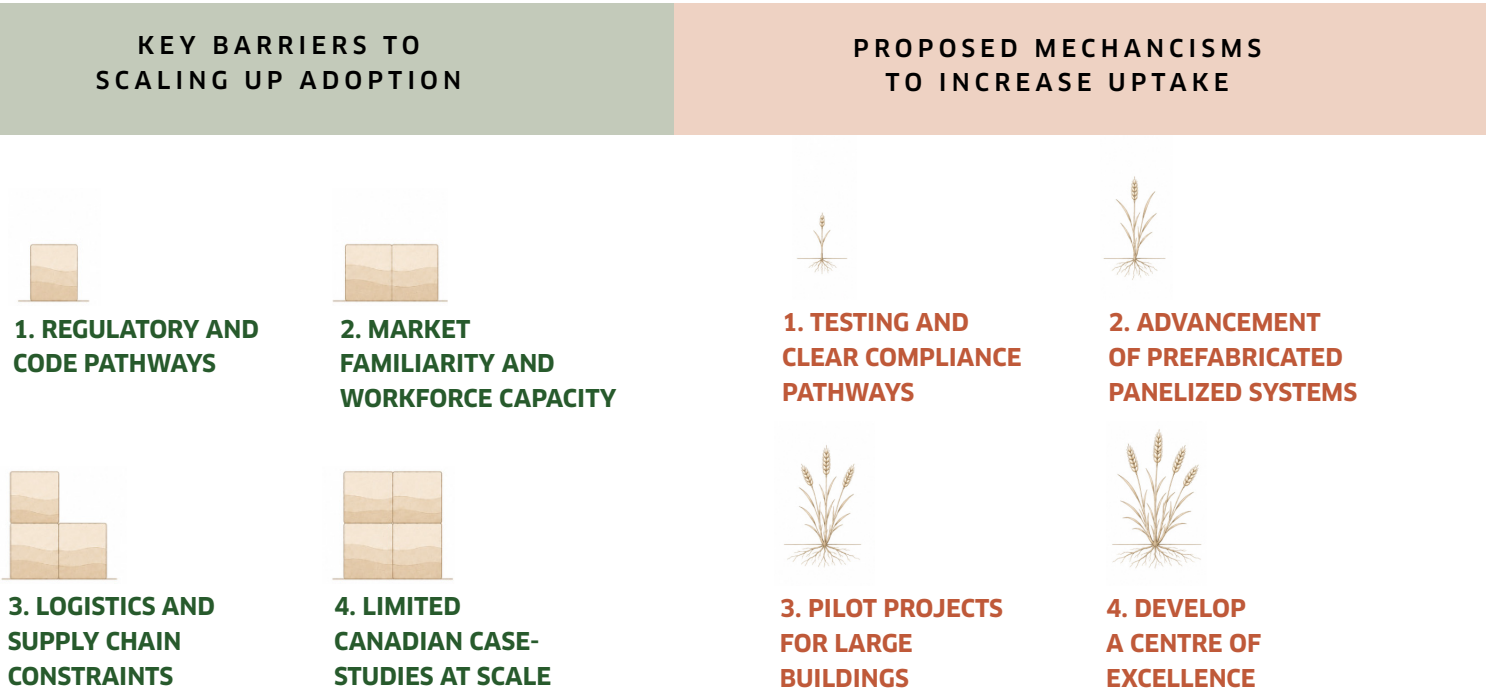
- Across materials, the barriers to scaling in larger buildings are less about technical feasibility and more about system readiness. Key constraints include:
- Limited availability of standardized, tested wall assemblies incorporating bio-based materials, particularly fire rated assemblies required for code compliance, increasing reliance on complex and costly alternative-solution pathways
  - Limited product knowledge and familiarity among designers, builders, and authorities having jurisdiction (AHJs), with uncertainty around insurance and warranty acceptance
  - Limited manufacturing and distribution capacity (including the logistics of transporting bulky, lightweight materials)
  - A shortage of Canadian precedents at scale that would otherwise reduce perceived risk and accelerate approvals.

International examples show that adoption accelerates when enabling conditions are built in parallel with material innovation. Leading jurisdictions, such as in France and Sweden, pair embodied-carbon policy signals, credible technical evaluation, and industrialized supply chains that support standardized, repeatable delivery models. These conditions shift bio-based construction from being perceived as experimental to becoming scalable climate solutions.

Canada is well positioned to scale bio-based materials at meaningful levels. The country has abundant biomass feedstocks, established expertise in wood construction, and increasing momentum around low-carbon procurement and “Buy Canadian” supply-chain resilience.

- To translate Canada’s feedstock advantage and growing market interest into mainstream adoption, the report proposes four complementary mechanisms to accelerate uptake:
1. Support coordinated testing, standardized performance evidence, and clearer compliance pathways to streamline approval of bio-based building assemblies
  2. Advance prefabricated, panelized bio-based envelope systems that improve consistency, scalability, and integration with conventional construction workflows
  3. Enable strategic pilot projects in larger (Part 3) buildings to create Canadian precedents, build confidence, and generate replicable templates for future projects
  4. Establish a Canadian peer-assessment function (e.g., a Center of Excellence) to provide structured technical review, publishable guidance, and clearer documentation for designers, AHJs, owners, and insurers
- Together, these mechanisms are intended to lower soft costs and schedule friction for project teams, improve consistency in regulatory and insurance review, strengthen domestic supply chains through increased demand, and accelerate learning across the market.

Through this white paper, CSBA is calling on the broader industry to accelerate the adoption of bio-based materials by aligning around the actions, partnerships, and implementation mechanisms needed to move these solutions from one-off applications to mainstream practice, delivering near-term embodied carbon reductions while creating economic opportunity across Canada’s forestry and agricultural value chains.





Upcycled Wood Panel Cladding at the Bill Fisch Forest Stewardship and Education Centre | DIALOG

# INTRODUCTION

## BUILDING CONSTRUCTION IS A MAJOR CONTRIBUTOR TO GLOBAL CARBON EMISSIONS

The global building sector accounts for approximately 39% of greenhouse gas (GHG) emissions, with 28% from building operations and 11% from building materials and construction [1]. These material-related emissions are known as embodied carbon - the emissions associated with the extraction, manufacturing, transportation, installation, and end-of-life of building materials.

As operational emissions are reduced due to energy efficiency improvements and electrification, embodied carbon is becoming a larger share of the building sector’s climate impact. The World Green Building Council estimates that nearly half of emissions from new construction between now and 2050 will come from embodied carbon [1]. Importantly, most embodied emissions occur at the beginning of a building’s lifecycle, during material production and construction. This highlights the time value of carbon: emissions released today have a greater impact on near-term warming than those emitted later. Reducing upfront embodied carbon therefore represents a critical opportunity for the construction sector to deliver immediate climate action.

## BIO-BASED MATERIALS AS A CLIMATE SOLUTION

One promising strategy is the use of bio-based building materials. Derived from renewable, biological resources such as plants and agricultural by-products, these materials can store biogenic carbon absorbed during plant growth. When incorporated into buildings, this carbon can remain stored for decades, effectively turning buildings into long-term carbon reservoirs. In addition, many bio-based materials require less energy-intensive manufacturing than conventional materials such as concrete, steel, and petrochemical-based insulation, further reducing embodied emissions. Beyond their carbon storage potential, sustainably produced bio-based materials can also support broader nature-based climate solutions by creating demand for practices such as regenerative

agriculture, sustainable forestry, and other land management approaches that enhance ecosystem health while sequestering carbon. As is the case for all building materials, the climate benefits of bio-based materials depend on sustainable sourcing and end-of-life management, including responsible harvesting and strategies for reuse, recycling, or composting.

## THE ECONOMIC OPPORTUNITY FOR CANADA

Canada is particularly well positioned to advance the uptake of bio-based materials. Expanding the use of bio-based materials can create new value-added uses for agricultural and forestry residues, generate employment in rural and regional communities, and stimulate innovation in manufacturing and prefabrication, supporting industries in transition such as pulp and paper. This opportunity aligns closely with growing interest in domestic procurement and “Buy Canadian” initiatives, which aim to strengthen local industries and increase resilience in construction supply chains.

Canada has already demonstrated leadership in bio-based materials through its forestry sector, particularly in the development and deployment of mass timber. Canada has a growing domestic mass timber manufacturing base, including: cross-laminated timber, glulam, and nail-laminated timber. Growth is linked to evolving building codes, growing expertise with builders and designers, and increased interest in green building practices [2].

The success of mass timber illustrates how coordinated investment in research, manufacturing capacity, and policy support can transform a natural resource into a globally competitive construction solution. A similar pathway can exist for other bio-based materials.

As the construction sector works to meet climate targets, bio-based materials offer a pathway to reduce embodied emissions while delivering broader environmental, economic, and social benefits. Understanding the current landscape, barriers to adoption, and opportunities for scaling these materials in Canada can support unlocking their full potential.

# ABOUT THIS WHITE PAPER

## PURPOSE

The Climate Smart Buildings Alliance (CSBA) is a coalition of building sector leaders aimed at accelerating the pathway to net zero, and driving climate action across the industry. Designed as a think-and-do tank, CSBA works with industry collaborators, governments, researchers and innovators to test ideas, prototype new solutions, and drive climate smart systems change.

This white paper was developed to advance industry understanding and uptake of carbon storing and bio-based materials in Canada’s built environment. This paper aims to:

- Synthesize current knowledge on bio-based and carbon storing materials by reviewing academic, industry, and policy literature.
- Identify high potential bio-based materials for the Canadian context by reviewing their carbon reduction potential, technical feasibility, scalability, and alignment with Canada’s climate, forestry, and agricultural sectors
- Propose actionable mechanisms to accelerate uptake of bio-based materials in Canada by examining current barriers and identifying opportunities for implementation within the Canadian context.

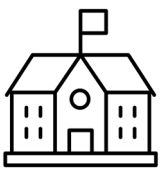
The paper is intended to provide practical insights that can support industry practitioners and policymakers in understanding barriers and advancing the use of bio-based materials in building construction.

## SCOPE OF REPORT

### Typologies:



Large Multi-Unit Residential

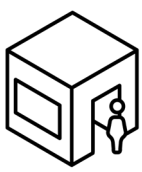


Institutional Buildings



Commercial Buildings

### Applications:



Building Envelope



Interior Applications

## METHODOLOGY

This research was undertaken by combining desktop research with targeted stakeholder outreach, within clearly defined boundaries:

- The scope of this study focuses on building applications where bio-based materials have the greatest potential for impact, with particular emphasis on building envelope systems and consideration for interior applications.
- Given the existing uptake of bio-materials in single family residential construction and the different challenges that face these buildings, this analysis prioritizes larger residential, institutional, and commercial building types,
- As mass timber structural systems are increasingly advancing in the Canadian market, they are not a primary focus of this study.
- The geographic focus is Canada, with selective international examples used to identify transferable lessons.
- Stakeholder outreach consisted of targeted interviews with industry experts involved in the development and delivery of bio-based materials. Interviews were used to validate findings from the desktop research, understand practical barriers, and to gather insights on scalability and mechanisms to accelerate adoption in the Canadian context.
- Desktop research included a review of academic literature, industry reports, policy documents, and existing case studies related to bio-based and carbon storing materials.

# CURRENT LANDSCAPE OF BIO-BASED MATERIALS

Bio based and carbon storing materials are moving from “niche” to increasingly viable options as the industry shifts its attention toward upfront embodied carbon. Amongst building owners, designers, and constructors, there is a growing focus on healthier, lower toxicity interior materials and circular economy strategies. This, in turn, is expanding interest in materials that can offer performance while improving human and ecosystem health.

## WHAT COUNTS AS BIO-BASED?

Bio-based building materials are materials derived wholly or partially from renewable biological resources, such as plants, agricultural residues, forestry products, fungi, or other organic matter [3]. According to the Bio-Based Materials Collective, these materials are distinguished from petroleum based products by the presence of “new” organic carbon that originates from biological growth rather than fossil carbon sources. A bio based material may undergo physical, chemical, or biological processing and can be made from purpose grown crops, forestry products, or biological by products and waste streams [3].

Importantly, being bio based does not automatically refer to a material’s environmental performance, toxicity, or sustainability outcomes, which depend on factors such as sourcing, land management practices, material composition, and lifecycle impacts [2].

## CANADIAN LANDSCAPE OF BIO-BASED MATERIALS

Canada is well-positioned to scale bio based materials because it has abundant biomass feedstocks and has a strong foundation of building industry expertise and technical capacity. Recent Canadian research highlights the magnitude of the opportunity: Canada produces large volumes of agricultural residues, forestry byproducts, and recyclable waste streams that could be converted into low carbon building products, supporting both emissions reductions and rural/industrial economic development [3]. In parallel, ongoing trade disruptions and uncertainty related to U.S.-Canada supply chains are also prompting interest in strengthening domestic manufacturing

and increasing the use of locally sourced building materials. This has created an additional strategic rationale for expanding Canadian bio-based material industries, reducing reliance on imported products. Despite this, market readiness is uneven.

The use of bio-based materials in Canada has generally been limited to the custom residential homes market, with examples of hempcrete, straw, and wood fibre growing. Builders for Climate Action have published insightful resources on the low-rise residential market, identifying that bio-materials are technically viable for Canadian construction, but remain under-utilized due to policy, code, market, and industry barriers [4].

In Canada, uptake in larger scale buildings remains limited to niche applications; constraints that are frequently cited include the lack of predictable compliance pathways, risk and insurer acceptance, limited options for logistics and distribution, and regional manufacturing capacity. These issues were consistently reinforced through stakeholder engagement conducted for this white paper.

The Canadian landscape is characterized by high technical promise but limited system readiness for widespread adoption in larger building types. At the same time, emerging national policy directions, such as efforts by the Canadian Board for Harmonized Construction Codes (CBHCC) to integrate embodied GHG considerations into future code cycles, signal a shift toward regulating embodied emissions at a systems level. This shift is expected to increase demand for low carbon building materials.

MATERIAL REVIEW LENS

To identify bio based materials with the greatest upscale potential to reduce embodied carbon in Canada’s built environment, we applied a high-level, qualitative assessment lens that reflects environmental performance and constructability. We reviewed bio-based materials across the following dimensions:

- Carbon and Environmental Performance  
Including embodied carbon reduction potential, biogenic carbon storage, availability of environmental product declarations (EPDs), and end of life circularity.
- Code and Risk Readiness  
Including clarity of building code pathways, fire performance testing, and insurance and warranty acceptance.
- Technical Performance  
Including thermal performance, moisture resilience, durability, and suitability for high performance building envelopes.
- Constructability and Industry Readiness  
Including ease of integration with common assemblies, installer familiarity, and compatibility with prefabrication.
- Market and Cost Considerations  
Including cost competitiveness today and demand signals from current and planned projects.
- Supply Chain and Scalability  
Including Canadian feedstock availability, domestic manufacturing capacity, logistics, lead times, and regional applicability.

This review framework informed both the prioritization of materials examined in detail in this report and the identification of systemic barriers and acceleration mechanisms required to support broader adoption.

HIGH POTENTIAL MATERIALS FOR THE CANADIAN CONTEXT

Based on this review, we identified wood, straw, and hemp as the highest potential bio based materials for scaling impact in Canada over the short to medium term.

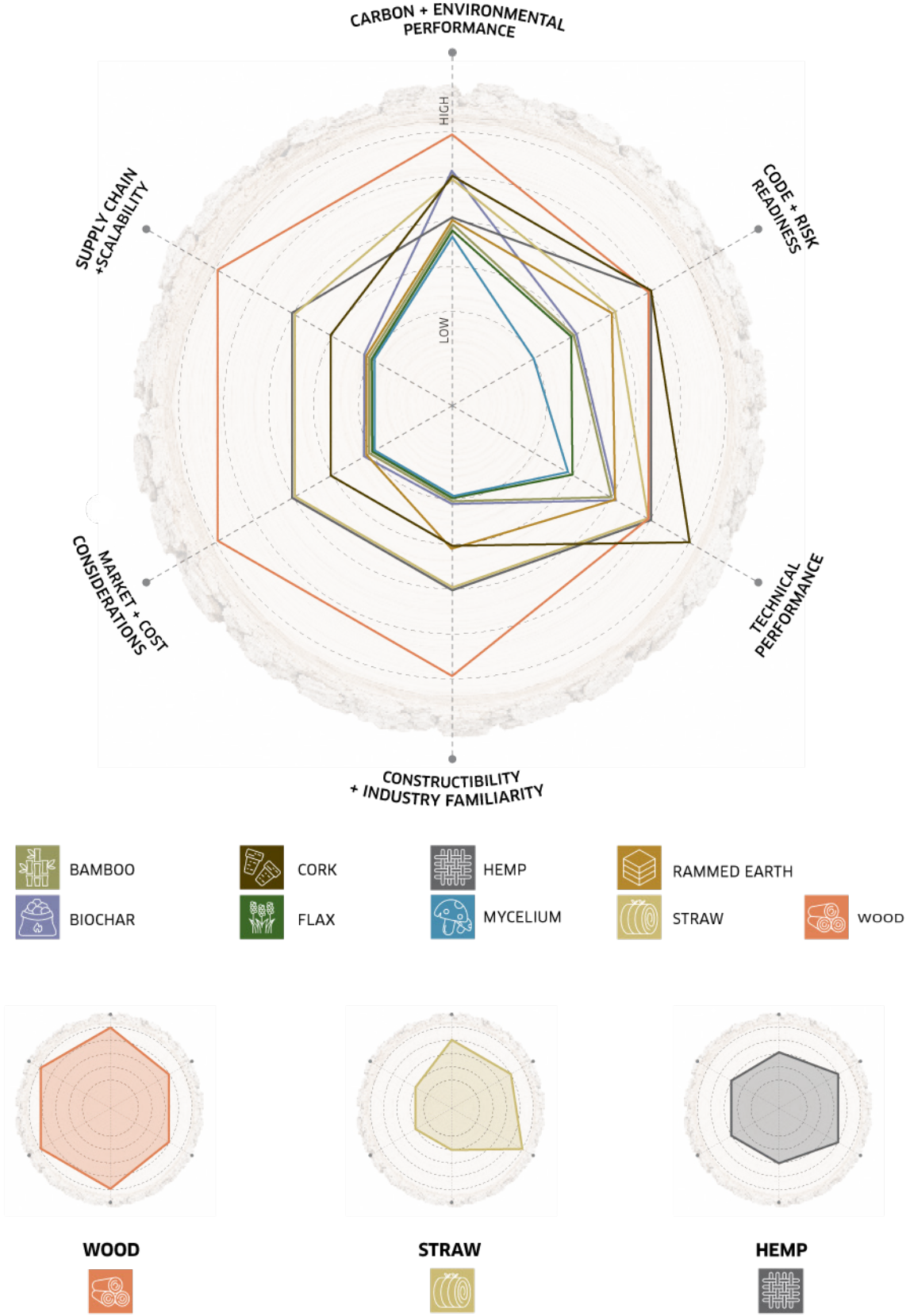
These materials share several distinguishing characteristics:

- Significant potential for embodied carbon reduction and long term carbon storage
- High domestic resource availability and alignment with Canada’s forestry and agricultural sectors
- Demonstrated performance in international large scale buildings
- Clear pathways for end-of-life circularity opportunities

Currently, broader adoption of these materials face several barriers, including:

- Limited domestic production
- Lack of standardized technical and environmental performance data
- Limited prescriptive code paths and complicated approvals
- Workforce education gaps
- Owner and designer risk aversion for new approaches

The next section reviews and summarizes the state of these three materials in Canadian construction. Emerging bio-based materials options that warrant further development were also identified and are summarized in the next chapter.





Wood based materials encompass a wide range of products derived from forestry resources, including engineered wood products (such as plywood and cladding panels), cellulose insulation, and wood fibre insulation and sheathing. This paper focusses on non structural wood based materials used primarily in building envelopes and interior applications.

Wood based materials offer strong potential for embodied carbon reduction due to two key factors: biogenic carbon storage and comparatively low manufacturing energy requirements. When wood is transferred from the forest to a building, it continues to store carbon. However, stored carbon is released back into the atmosphere at end-of-life if this wood decays in landfill or is incinerated. As such, wood’s environmental performance is closely tied to forest management practices, and end of life scenarios, underscoring the importance of sustainable sourcing and recycle or re-use strategies.

Cellulose insulation is already a proven, widely available insulation material that delivers operational energy savings and net carbon storage, and is treated as a conventional insulation material by building codes, making it one of the most effective and readily deployable tools for reducing embodied carbon in residential buildings today. Because it is made primarily from recycled paper fibres, the biogenic carbon stored in the material exceeds the emissions from manufacturing, transport, and installation, resulting in a negative embodied carbon value [6].

Wood fibre products are generally derived from soft-wood and hardwood species; the fibres are processed into insulation panels, boards, batts, loose fill, and sheathing products. These materials can replace higher emissions products such as foam plastics, mineral wool, and gypsum in walls, roofs, and floors, while remaining compatible with contemporary construction methods.

Wood fibre and cellulose products provide competitive thermal performance, with thermal conductivity values comparable to conventional insulation types.

ADOPTION IN CANADA COMPARED TO INTERNATIONAL CONTEXTS

Wood based products are the most established and widely accepted in the Canadian market. Products such as plywood sheathing, wood cladding, and cellulose insulation are already common in residential and low rise construction. Wood fibre insulation is continuing to gain interest and traction, with Quebec Manufacturer MSL producing the SONOclimat ECO4 product, a 100% wood fibre insulation board..

Canada’s adoption has lagged somewhat in non residential and large building applications, not due to technical constraints, but because of cost sensitivity, clear code pathways, supply chain maturity, and market familiarity.

While wood fibre insulation is not currently treated as a conventional insulation material in Canadian building codes, international precedents exists. For example, TimberHP, a U.S.-based manufacturer of wood fibre insulation, has completed full scale fire testing of wall assemblies incorporating wood fibre insulation products, enabling approval through prescriptive code pathways rather than project specific alternative solutions.

GLOBALLY AVAILABLE BUILDING PROODUCTS DERIVED FROM WOOD

| Material                        | Available Products [12]                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| ENGINEERED WOOD PRODUCTS        | <ul style="list-style-type: none"><li>Exterior Cladding Panels</li><li>Plywood Sheathing</li><li>Interior Finishes</li></ul>               |
| CELLULOSE (PROCESSED WOOD PULP) | <ul style="list-style-type: none"><li>Rigid and Batt Insulation</li><li>Interior Finishes (Acoustic Panels)</li></ul>                      |
| WOOD FIBER                      | <ul style="list-style-type: none"><li>Sheathing Panels (Fiber-board)</li><li>Rigid and Batt Insulation</li><li>Interior Finishes</li></ul> |

CANADIAN MARKET READINESS

Canada is uniquely positioned to scale wood based materials due to its extensive forestry resources, established manufacturing base seeking new products and markets, and existing expertise in wood construction. Based on research conducted by the Bioeconomy & Sustainable Materials Institute, Canada currently ranks behind EU and China in converting biomass into high-value bio-based products, despite having large forested areas.

From an industry perspective, cellulose insulation is often viewed as an entry point into bio-based materials for project teams seeking to reduce

embodied carbon without introducing unfamiliar assemblies or approval pathways [6].

Key challenges remain for increased uptake of a greater variety of wood-based products. Cost competitiveness with plastic and mineral based materials can vary by region, particularly where products are imported or where freight distances are significant. In addition, awareness of wood fibre insulation among mainstream practitioners is still uneven, with many teams defaulting to familiar material choices.

Wood Cladding at the Fort Wellington Visitor Reception Centre | DIALOG





Straw is the dry stalk left over after harvesting cereal grains such as wheat, barley, oats, and rye [7]. While it has historically been used in straw bale construction, modern approaches are evolving towards engineered and prefabricated systems, especially straw-insulated panels for walls, roofs, and select floor assemblies. In these systems, compressed straw is enclosed within a structural frame and finished with vapor-permeable layers, enabling both thermal resistance and moisture resilience when properly detailed. A range of straw based products are used in the manufacturing of panelized wall, floor, and roof systems in Canada and internationally. Table 2 summarizes the straw products currently available in global markets [3].

Straw’s physical structure inherently traps air, providing effective insulation value, and its resistance to rot and flame charring under high heat contributes to performance without toxic chemical additives [7]. Straw assemblies can achieve high thermal performance, often comparable to conventional insulation products, while remaining compatible with offsite manufacturing and modern building practices [3]. Contrary to common assumptions, densely packed straw is highly fire resistant: limited oxygen, protective plaster layers, natural silica content, and a surface char layer allow straw assemblies to withstand extreme temperatures for extended periods [8].

Straw, as an agricultural residue that requires minimal processing, can have lower embodied carbon compared with conventional insulation products. Because straw inherently stores carbon that would otherwise remain in agricultural fields, buildings constructed with straw elements can act as carbon storage [7].

As a natural, bio-based material, straw contains no added toxic chemicals and is typically used with vapor permeable finishes like lime or earth, which can help regulate humidity and reduce the risk of condensation and mold when properly detailed [10]. Additionally, straw assemblies often provide effective acoustic insulation and a natural, biophilic aesthetic.

ADOPTION IN CANADA COMPARED TO INTERNATIONAL CONTEXTS

Although straw’s potential is widely recognized, its real-world adoption in Canada remains limited. In Canada, straw systems are primarily used in custom single-family residential projects. This contrasts with regions in Europe, where straw has been incorporated into multi-storey residential, commercial, and industrial buildings supported by manufacturer standardization, such as the Bestseller Logistics Center West in the Netherlands designed by architects Henning Larsen and incorporates straw wall panels by EcoCocon [9].

For large buildings in Canada, however, straw materials are not explicitly recognized in the National Building Code, requiring alternative compliance pathways or site-specific approvals. This gap increases perceived project risk and cost while slowing down adoption, particularly for non residential and multi-unit buildings [7]. While panelized straw systems can help address some of these barriers by enabling standardized testing and factory-controlled fabrication, they still generally require alternative solution approvals.

GLOBALLY AVAILABLE BUILDING PROODUCTS DERIVED FROM STRAW

| Material       | Available Products [12]                                                                                                                                 |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| STRAW BALES    | <ul style="list-style-type: none"><li>Insulation Blocks</li></ul>                                                                                       |
| LONG STRAW     | <ul style="list-style-type: none"><li>Compressed Straw Board</li></ul>                                                                                  |
| SHREDDED STRAW | <ul style="list-style-type: none"><li>Flexible Batt Insulation</li><li>Rigid Lightweight Panels</li><li>Straw Medium Density Fiberboard (MDF)</li></ul> |
| CHOPPED STRAW  | <ul style="list-style-type: none"><li>Loose Fill Insulation</li><li>Oriented Straw Board</li></ul>                                                      |

CANADIAN MARKET READINESS

Canadian farms produce approximately 64 million tonnes of grain straw annually. Even after accounting for competing uses, insulating 700,000 homes would require only about 20% of the accessible supply, highlighting the significant potential for straw to support climate aligned buildings at scale [3]. While some straw residues can play an important role in maintaining soil health and soil carbon, the available supply remains substantial, and creating markets for a portion of this resource can provide additional revenue streams for farmers when managed

sustainably. Using straw to manufacture building products can support rural economic development by creating new markets for agricultural residues, generating local jobs, and strengthening regional supply chains tied to farming communities [10]

However, broader adoption of straw continues to face several barriers including lack of testing data, risk aversion, lack of prescriptive code paths, and workforce education gaps.

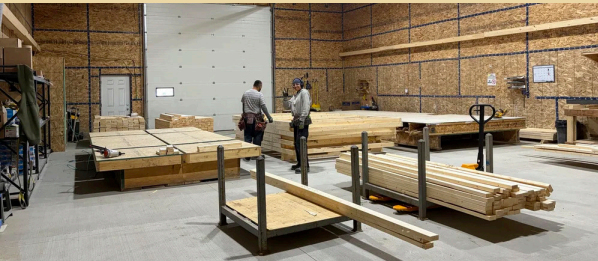
INTERVIEW WITH SAMUEL KONDRATSKI, FOUNDER SAVICK INC.

Savick Inc. is a Canadian manufacturer of prefabricated straw-insulated panel systems for building envelopes. The company produces engineered wall assemblies that use compressed straw insulation within panelized systems intended for high-performance buildings.

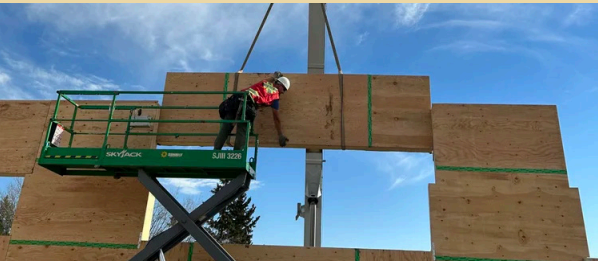
In an interview, Kondratski highlighted growing interest in straw construction beyond single-family homes, particularly from projects pursuing high performance energy standards, low carbon construction, and healthier indoor environments. Kondratski emphasized that prefabricated straw panels can offer strong thermal performance, vapour-permeable enclosure design, and fire performance without relying on added chemical treatments, while also supporting greater quality control through off-site fabrication.

Kondratski indicated that broader adoption will depend not only on technical viability, but also on how well these systems fit within conventional project delivery. In particular, he noted that panelized straw systems benefit from early coordination, integrated design, and engagement from enclosure specialists.

The discussion also highlighted several factors that could accelerate adoption in Canada, including pilot projects, workforce training, stronger collaboration across the construction industry, and better alignment between available agricultural feedstocks and manufacturing capacity. While straw is technically viable and widely available in Canada, Kondratski suggested that broader adoption will depend on strengthening supply chains, improving familiarity among owners and building professionals, and creating more visible precedents in larger projects.



Straw Insulated Panel Systems | Savick



Straw Insulated Panel Construction | Savick



In Canada, hemp is considered a dual-purpose crop, traditionally grown for hemp seed used in food products and for fibre applications, but is increasingly being cultivated specifically to supply the growing building materials market. While purpose-grown, industrial hemp can enhance soil health and support biodiversity through erosion control, biomass inputs, and supplying pollinator resources.

Hemp used in construction is derived from industrial hemp, a fast-growing crop cultivated for shiv or hurd (inner woody core of the hemp stalk). It is important to distinguish this from cannabis grown for recreational or medicinal use, as industrial or construction grade hemp is specifically bred for fibre and material applications. Hemp's bast fibres (bark or skin of hemp stalk) are lightweight, durable, and flexible, making them suitable for insulation and composite materials, while the porous, silica rich hurd provides strong thermal and acoustic performance in products like hempcrete and fibre panels. When combined with lime, hemp materials also achieve natural fire resistance and enhanced sound absorption [3].

Hemp based construction materials are valued for their thermal insulation properties, vapor permeability, and moisture buffering capacity. Hempcrete walls are also a form of thermal mass, helping to moderate indoor temperatures and reduce energy demand. Because hempcrete is vapor permeable, it can regulate moisture within wall assemblies, reducing the risk of condensation and mold when properly detailed [11].

Hemp absorbs and stores high volumes of CO2 in the plant and the soil [3]. Hemp-based materials can also contribute to occupant health when products contain no added petrochemicals. Hemp materials also provide acoustic insulation and humidity regulation, which can improve overall indoor environmental quality. However, as a purpose-grown crop, scaling production must be carefully managed, as overcultivation can lead to water stress, chemical pollution, and land use change that may displace food production or habitats, contributing to biodiversity loss [2].

ADOPTION IN CANADA COMPARED TO INTERNATIONAL CONTEXTS

Despite a wide range of applications and growing markets globally, hemp remains an underutilized resource in Canada. Currently, only a handful of Canadian companies produce hemp-based building products and they are used primarily in custom single family homes. In contrast, countries such as France and the United Kingdom have integrated hempcrete into multi-unit residential, institutional, and commercial buildings.

In Canada, hemp-based materials are not yet fully embedded within prescriptive building code pathways. While hempcrete is recognized in the U.S. under the International Residential Code (Appendix BL) and has demonstrated reliable thermal performance and strong fire resistance, Canadian projects typically require alternative compliance pathways or site specific approvals. Hemp insulation batts have undergone testing and, in at least one case (Quebec based manufacturer Nature Fibres), received Canadian Construction Materials Centre (CCMC) approval, indicating a growing broader acceptance [3].

GLOBALLY AVAILABLE BUILDING PROODUCTS DERIVED FROM HEMP

| Material       | Available Products [12]                                                                                                                                             |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BAST FIBER     | <ul style="list-style-type: none"><li>Flexible Batt Insulation</li><li>Rigid Lightweight Panels</li><li>Carpet Underlayment</li><li>Loose Fill Insulation</li></ul> |
| COMPLETE STALK | <ul style="list-style-type: none"><li>Compressed Board for Flooring Trim</li><li>Sheathing Panels</li></ul>                                                         |
| HURD/SHIV      | <ul style="list-style-type: none"><li>Semi-Rigid Insulation (Hempcrete)</li><li>Insulation Block (Hempcrete)</li><li>Aggregate</li></ul>                            |

CANADIAN MARKET READINESS

Hemp cultivation in Canada remains concentrated in the Prairie provinces, with approximately 90% produced in Alberta, Saskatchewan, and Manitoba [3]. While current production is modest, Canada's agricultural capacity presents a strong opportunity to scale hemp as a construction feedstock. Expanding hemp based construction could also support rural economic development by creating new value added markets and regional processing opportunities.

However, broader adoption faces several barriers

such as limited domestic processing capacity for construction grade hemp. From a supply chain perspective, only a small number of facilities in Canada are equipped to process hemp at scale. Since the legalization of industrial hemp in 1998 in Canada, the industry has grown rapidly, though it remains hindered by regulatory inconsistencies and stigma due to its confusion with marijuana [12]. In speaking with builders in Canada, it was identified that hempcrete constructability can be limited as standard tools for insulation install are not compatible with the product.

INTERVIEW WITH BRANDON COCHRAN, FOUNDER HEMPWORKS

HempWorks is a Canadian manufacturer of hempcrete building envelope systems that also distributes hemp batt insulation and HempWood product lines nationally. These products leverage hemp fibre to create insulation and wall systems that offer low embodied carbon, fire resistance, and moisture-regulation.

In an interview conducted as part of this research, Cochran highlighted growing interest in hemp based materials in Canada, particularly among projects seeking healthier indoor environments, improved fire resilience, and lower carbon footprints. Hemp batt insulation has completed the Canadian Construction Materials Centre (CCMC) evaluation process, enabling broader acceptance by building authorities. Hempcrete, meanwhile, is increasingly being explored as a full above grade envelope system that provides insulation, moisture regulation, and acoustic benefits.

Cochran emphasized that scaling hemp based construction requires addressing logistics and supply chain constraints, particularly related to the transportation and storage of bulky materials. Current costs are influenced by freight and distribution challenges. The company is exploring strategies such as warehousing and regional facilities to improve efficiency and reduce costs. The discussion also noted the growing interest in hemp based materials and the inclusion of hempcrete within U.S. building codes.



Hemp Batt Insulation | HempWorks



Hempcrete | HempWorks

# EMERGING MATERIALS

Our review also captures a set of materials with credible long-term potential but lower near-term scalability in Canada. Many of these materials provide excellent environmental benefits, and should continue to be advanced in the industry through the long term.

| Material                                                                                            | Available Products [12]                                                                                                                                                              | Applicability to Scaling Up in Canadian Construction                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>Bamboo         | <ul style="list-style-type: none"><li>• Sheathing</li><li>• Cladding</li><li>• Interior Finishes such as flooring</li></ul>                                                          | Bamboo has rapid growth properties, low embodied carbon, and is highly durable. However, it lacks a domestic supply chain, local installer familiarity, and presents durability and moisture performance uncertainties in cold, wet Canadian climates.                                                                                                                                   |
| <br>Biochar        | <ul style="list-style-type: none"><li>• Cement replacement for concrete</li><li>• Insulation when coupled with binder</li></ul>                                                      | Biochar is emerging as a promising carbon reduction strategy due to its high potential for durable carbon storage when embedded in concrete or composites, but current use is largely limited to pilots and proprietary formulations.                                                                                                                                                    |
| <br>Cork         | <ul style="list-style-type: none"><li>• Cork Board Insulation</li><li>• Acoustic Tile</li><li>• Interior Finishes</li><li>• Interior Partitions</li></ul>                            | Cork has great environmental benefits such as low embodied emissions and high durability. However, cork trees do not grow in Canada and remains import dependent, limited in applications, and has relatively low mainstream demand.                                                                                                                                                     |
| <br>Flax         | <ul style="list-style-type: none"><li>• Acoustic Panels</li><li>• Interior Finishes</li></ul>                                                                                        | Flax exhibits good environmental benefits, however flax that is grown commercially for oil and fibre in Canada, while well understood, is not a native species and is mostly limited to interior applications.                                                                                                                                                                           |
| <br>Mycelium     | <ul style="list-style-type: none"><li>• Not commercially available in Canada, early examples exist of flooring, insulation, plywood, and acoustic tiles in other countries</li></ul> | Mycelium delivers on high degrees of biodegradable and compostable properties, however the use of mycelium in building products is in the early research and pilot stage, having limited long term durability evidence.                                                                                                                                                                  |
| <br>Rammed Earth | <ul style="list-style-type: none"><li>• Structural Walls</li><li>• Cladding</li><li>• Partitions</li></ul>                                                                           | Rammed earth has low processing needs, with strong local material use, durability, fire resistance, and end of life circularity. However, its use requires specialized detailing and engineering, and faces high labor intensity and limited contractor familiarity. Rammed earth is commonly custom manufactured, limiting its scalability, as well as limited biogenic carbon storage. |

# INTERIOR APPLICATIONS

While building structure and envelope systems offer some of the largest opportunities for embodied carbon reductions due to the scale of materials used, interior applications also represent a meaningful and underleveraged area for impact. When lifecycle replacement impacts are considered, interior materials can represent a significant portion of a building’s embodied carbon emissions. Compared to structural and envelope systems, interior components are typically replaced far more frequently over a building’s lifecycle, which can limit the potential for long-term biogenic carbon storage unless circularity strategies are implemented.

In addition, interior applications may not face the same regulatory and code-related barriers as envelope, providing opportunity for integration of bio-based materials, though some barriers such as flame-spread ratings still apply. As such, interior applications can serve as an accessible entry point for broader adoption.

To better understand the role bio-based materials can play within interior design, we conducted a high-level scan of current adoption patterns, material availability, and perceived barriers within the Canadian market.

### KEY TRENDS AND CHALLENGES

Some luxury and specialty bio-based materials are already used for their aesthetic appeal, but have low potential for broader adoption due to cost and performance in high-traffic environments. These materials are well understood and widely available but are typically specified for appearance rather than sustainability benefits, often in high-end projects. For example, wool felt is common in luxury residential, hospitality, and high-end commercial interiors, and is often replaced with recycled plastic felt when cost barriers are present.

Some bio-based materials face perception or performance barriers, but have potential for high environmental impacts. These materials are readily available, but may be avoided due to falling short of meeting current design trends, durability concerns, or performance requirements. For example, linoleum,

a bio-based flooring material made from linseed oil and wood-based ingredients, has been long available in Canada but underused due to stigma associated with past design trends. In addition, bio-based textiles (upholstery and wallcoverings) are seeing growing interest, but many options struggle to meet commercial durability ratings, fire requirements, cost expectations, or aesthetic preferences.

In many cases, interior fit outs are more directly influenced by tenant experience, corporate sustainability commitments, and leasing and branding objectives than by code or structural constraints. Overall, demand for bio-based materials in interior applications is likely to grow as clients increasingly seek low-carbon, healthier material options, and as project teams gain greater awareness, clearer specification guidance, and better access to products through stronger supply chains.

Natural Stone and Wool Felt | Mawer Toronto Office



# KEY BARRIERS TO SCALING UP ADOPTION IN CANADA

Despite strong technical performance and growing market interest, several systemic barriers continue to limit adoption of bio based materials in larger residential, institutional, and commercial buildings.

## 1. REGULATORY AND CODE PATHWAYS

Building codes in Canada play a critical role in shaping material adoption and, while not inherently prohibitive, often act as a practical barrier to scaling bio-based materials, particularly in larger buildings. Bio based assemblies typically require alternative solutions supported by project specific engineering and testing. This creates added cost, uncertainty, and approval timelines.

For example, while combustible materials are permitted in certain exterior wall assemblies in Ontario Building Code (OBC) Part 3 (non-combustible) buildings, these allowances are conditional and complex, making them difficult to interpret and apply in practice. As a result, project teams often default to conventional materials, even where bio-based options may be technically viable.

A key barrier is the reliance on the alternative solution pathway, which requires demonstrating that a proposed system meets the intent of the code. While this enables innovation, it introduces additional time, cost, and perceived risk, particularly for teams unfamiliar with the process. The code is generally effective at regulating established systems but is less equipped to accommodate newer materials, placing the burden of proof on early adopters.

Fire performance requirements can complicate adoption, not because bio-based materials are inherently unsafe, but because building codes assess fire performance at the assembly level in addition to individual materials. Even when a bio-based material demonstrates satisfactory fire rating on its own, it must be incorporated into a full wall assembly that has been tested and validated to demonstrate compliance. These assembly level fire resistance tests are technically and financially demanding, and

the cost is often prohibitive for smaller bio-based material suppliers. As a result, the primary constraint to broader adoption is not combustibility, but the limited availability of tested, code recognizable wall assemblies, which restricts designers and approval authorities to project specific alternative solutions rather than standardized, pre-approved systems.

International precedents such as TimberHP wood fibre insulation assemblies in the United States and EcoCocon prefabricated straw panels in Europe demonstrate that bio-based envelope systems can meet stringent fire resistance requirements when tested as complete assemblies. TimberHP products such as TimberBatt, TimberFill, and TimberBoard have been tested within complete wall assemblies to standards such as ASTM E119 and UL263, enabling ICC-ES listings and approval through prescriptive code pathways rather than project specific alternative solutions. This demonstrates that bio-based materials can meet mainstream fire, permitting and insurability requirements when supported by standardized testing and evaluation pathways, offering a relevant precedent for the Canadian market.

Finally, knowledge gaps across the industry, including among designers, contractors, and building officials, contribute to conservative decision making. Limited awareness of existing code allowances and a lack of standardized guidance make it more difficult to confidently specify bio-based materials in larger projects.

Overall, while the code allows for innovation, complexity, cost and limited standardization act as key barriers to the broader adoption of bio-based materials in Canada.



## 1. REGULATORY AND CODE PATHWAYS



## 2. MARKET FAMILIARITY AND WORKFORCE CAPACITY



## 3. LOGISTICS AND SUPPLY CHAIN CONSTRAINTS



## 4. LIMITED CANADIAN CASE STUDIES AT-SCALE

## 2. MARKET FAMILIARITY AND WORKFORCE CAPACITY

A major barrier to wider adoption is the limited familiarity with bio-based materials across designers, contractors, regulators, and insurers. While mass timber has gained increasing acceptance, most other bio-based systems remain relatively unfamiliar, leading to slower specification, approval, and construction processes, particularly in larger projects where perceived risk is higher.

This unfamiliarity is reinforced by persistent stigma among clients and end users, who often question the durability, fire performance, and long-term reliability of bio-based materials compared to conventional alternatives. Even when performance data exists, lack of exposure and precedent reduces confidence in real world applications.

Stakeholder engagement highlighted that workforce

knowledge gaps extend across the entire delivery chain, including design teams, building officials, and installers. In practice, this results in conservative material selection and reliance on familiar assemblies, even where bio-based alternatives are technically viable.

At the same time, grassroots initiatives are beginning to address this gap. For example, the Toronto Biobuild Collective is actively advancing knowledge sharing and industry engagement around bio-based construction. The group includes participation from multiple design firms and practitioners and is developing hands on initiatives such prototyping bio-based wall assemblies. These efforts play an important role in bridging the gap between research and practice, while increasing confidence in the application of bio-based materials in real building systems.

### TORONTO BIOBUILD COLLECTIVE

#### Industry Advocacy to Support Integration of Sustainable, Bio-Based Materials into MainStream Construction



The Toronto BioBuild Collective is an emerging example of how grassroots, multi-firm collaboration can help address barriers related to limited market familiarity and workforce capacity. The collective brings together architects, engineers, researchers, students, and other construction-industry participants around a shared goal of integrating sustainable, bio-based materials into mainstream construction practice. By creating space for recurring dialogue, peer learning, and cross-disciplinary exchange, the collective helps build the awareness and confidence needed to move bio-based materials from a niche interest to practical specification.

What makes the Toronto BioBuild Collective especially relevant is its focus on practical learning rather than advocacy alone. Public events and workshops have explored how bio-based materials can be integrated into Toronto's construction industry. More recently, the collective has launched a collaborative mock-up initiative in which several architecture firms are developing and constructing wall-assembly prototypes aligned with real project typologies, allowing teams to test materials, detailing strategies, and assess constructability.

Initiatives like the Toronto BioBuild Collective do not replace the need for formal testing, code pathways, or supply-chain development, but illustrate how industry-led advocacy can complement broader bio-based material adoption.

3. LOGISTICS AND SUPPLY CHAIN CONSTRAINTS

Logistics and supply chain limitations are a consistent barrier to scaling bio-based materials in Canada. While materials such as wood, straw, and hemp are abundant at the raw resource level, the infrastructure required to process, manufacture, and distribute them into construction ready products remains underdeveloped in Canada. A key challenge is the lack of regional processing capacity. For example, manufacturing of engineered products like straw panels is still concentrated among a small number of producers. This creates bottlenecks that limits availability and make it difficult to supply larger projects reliably. The limited number of Canadian manufacturers contributes to higher material costs, largely driven by constrained supply and low production volumes rather than raw material and manufacturing costs.

Transportation further complicates the issue. Many bio-based materials are lightweight but bulky, meaning they are inefficient to transport over long distances. In the absence of local manufacturing hubs, materials often need to be shipped across provinces driving up costs, increasing associated transportation-related emissions and increasing project risk. In some cases, logistics and freight costs become a primary driver of overall material cost, making bio-based options less competitive with conventional products.

There are also scaling challenges tied to production models. Some bio-based systems rely on custom fabrication or smaller batch production, which can limit speed, consistency, and capacity when compared to highly industrialized conventional materials. While prefabrication offers a pathway to improve efficiency and quality control, it requires upfront coordination, early design decisions, and alignment with existing construction workflows.

As demand grows, improving supply chain coordination and infrastructure will be critical to enabling bio-based materials to compete at scale in the Canadian construction market.

4. LIMITED CANADIAN CASE STUDIES AT SCALE

A persistent barrier to broader adoption of bio-based materials in Canada is the limited number of demonstrated multi-unit, institutional, and commercial projects at scale, which creates a reinforcing cycle of risk aversion across the industry. Developers, insurers, and approval authorities often rely heavily on prior examples to validate performance expectations, meaning that without Canadian case studies, bio-based materials are frequently perceived as higher risk even when international evidence suggests otherwise.

Although strong global precedents exist, Canadian examples that reflect local climate conditions, locally available materials, code requirements, and procurement processes are important to accelerate bio-based materials uptake. Domestic projects are seen as more credible benchmarks for regulators and project teams than international case studies, particularly when navigating building code compliance.

The limited number of Canadian projects also means there is relatively little long-term performance data on durability, moisture management, and maintenance requirements under Canadian climate conditions. While these issues were raised as common concerns by industry stakeholders, the lack of sufficient case studies means they have not yet been fully validated in practice. As more projects are built and monitored over time, these performance considerations are expected to become better understood, helping to reduce uncertainty and inform best practices.

Recent projects, such as the Trent University forensic science facility, can be seen as an early signal of what is possible in the Canadian context. These types of institutional projects help demonstrate that bio-based materials can be successfully integrated into more complex building typologies while meeting performance, durability, and compliance requirements. However, stakeholders also noted that such examples remain limited and not yet sufficient to shift mainstream industry practice.

FORENSICS CRIME SCENE FACILITY | CASE STUDY

**Owner:** Trent University  
**Location:** Peterborough, Ontario  
**Architect:** Christopher Z. Tworkowski  
**Zero-Carbon Design:** Endeavour Centre / Chris Magwood

**Program:** Forensic Science Training Facility  
**Bio-Materials:** Hempblocks, Hemp Batt, Cellulose Roof Insulation, Charred Wood Siding, Glavel, Wood Fiberboard Insulation [24]  
**Area:** 4,100 square feet

The Trent University Forensics Crime Scene Facility in Peterborough, Ontario, represents a pioneering approach in bio-based construction in Canada, showcasing the integration of multiple low-carbon materials in a high-performance institutional building. Developed with guidance from the Endeavour Centre, the facility uses a combination of hemp blocks, hemp batt insulation, cellulose roof insulation, charred wood siding, and Glavel to achieve a zero-carbon, sustainable design. In 2024, the facility became the first building in Canada to receive the International Living Future Institute’s Zero Carbon Certification [24].

KEY SUCCESS FACTORS

- Material Selection for Carbon Reduction and Storage:** The project replaced high impact base case materials with bio-based and low carbon alternatives, reducing over 185 tonnes of carbon emissions and achieving a minimal carbon intensity of 60 kg CO2e/m2, an 88% reduction from the baseline case before accounting for additional carbon stored in timber products and charred wood siding [13]. Timber elements were sourced locally, allowing the building to store more carbon than was emitted in producing the materials.
- High Performance Envelope and Energy Efficiency:** The project combined low-carbon materials with a high-performance enclosure and on-site solar generation. Insulation levels were upgraded and the enclosure achieved Passive House level airtightness [24].
- Integrated Design Approach:** Every material was assessed for embodied carbon impacts using the BEAM tool, allowing targeted improvements while maintaining cost effectiveness.

BARRIERS ENCOUNTERED

- Supply Chain:** The team encountered some barriers with supply chain and sourcing some carbon storing materials [24].
- Material Construction Familiarity:** The team had limited construction experience with bio-based and alternative low carbon materials [13].

Building Exterior | Endeavour Centre



Hempblocks Construction | Endeavour Centre



# THIRD SPACE COMMONS | CASE STUDY

|                                                  |                                                                          |
|--------------------------------------------------|--------------------------------------------------------------------------|
| <b>Client:</b> University of British Columbia    | <b>Program:</b> Teaching and Learning Space                              |
| <b>Location:</b> Vancouver, BC                   | <b>Bio-Materials:</b> Hempcrete Walls, Cellulose Insulation, Mass Timber |
| <b>Architect:</b> Third Quadrant Design, DIALOG  | <b>Area:</b> 2,400 sq. ft.                                               |
| <b>Zero-Carbon Design:</b> Third Quadrant Design |                                                                          |

Designed and constructed by a student-led interdisciplinary team participating in the 2023 U.S. Solar Decathlon Build Challenge, Third Space Commons was conceived as a low carbon “living lab” for experiential learning. The project prioritizes carbon minimalism through the use of hempcrete wall assemblies, blown in cellulose insulation, mass timber structure, and extensive reuse of reclaimed building components, including high performance windows and a photovoltaic system [25].

### KEY SUCCESS FACTORS

- Embodied Carbon Reduction Through Material Substitution and Sequestration:** Conventional high carbon materials were replaced with lower carbon and bio based alternatives. Hempcrete wall assemblies were selected for their carbon sequestration potential, while cellulose insulation was used in place of XPS and EPS. A whole building life cycle assessment demonstrated a 74% reduction in total embodied carbon compared to a baseline building, with a carbon intensity of approximately 83 kg CO<sub>2</sub>e/m<sup>2</sup> [25].
- Integrated and Iterative Carbon Modelling:** Iterative life cycle assessment and energy modelling informed decisions related to envelope design,

structural systems, and mechanical strategy, allowing the team to prioritize lowest carbon solutions at each stage without compromising basic performance requirements.

- Demonstration of Bio-based Materials in Canadian Institutional Contexts:** Third Space Commons shows that bio-based materials such as hempcrete and cellulose insulation can be successfully deployed in institutional buildings in Canada.

### BARRIERS ENCOUNTERED

- Limited Familiarity and Technical Experience with Bio-based Materials:** Despite their carbon advantages, materials such as hempcrete are still novel within the Canadian construction industry. This resulted in additional time and effort for coordination, training, and on site experimentation, highlighting the current skills gap and knowledge barriers facing wider adoption of bio based construction methods.
- Data Gaps and Modelling Limitations:** Conducting a life cycle assessment was constrained by limited availability of environmental product declarations (EPDs) for certain building services and innovative materials, requiring the use of proxies and supplementary research.



Building Interior | UBC Third Space Commons [25]



Building Exterior | UBC Third Space Commons

# GLOBAL LANDSCAPE

Bio-based and carbon-storing materials are increasingly recognized globally as a high impact strategy for reducing the built environment’s climate footprint. In leading markets, bio-based adoption has progressed beyond isolated pilot projects because material innovation is paired with enabling conditions that reduce uncertainty for owners, regulators, and project teams.

Across global markets, adoption is consistently strongest where three conditions align:

- Lifecycle carbon requirements and clear market signals  
Jurisdictions that require or strongly incentivize lifecycle assessments and carbon reduction over a building’s lifecycle create stable demand for low carbon and carbon storing products.
- Credible pathways to evaluate, approve, and insure “non traditional” systems  
Where there are clear evaluation mechanisms, bio-based systems are more readily accepted by insurers, building officials, and technical reviewers.
- Industrialized supply chains and product standardization  
Markets with established prefabrication capacity, standardized product systems, and mature distribution networks are better able to deliver bio-based building assemblies with consistent quality, predictable costs, and scalable delivery.

Together, these conditions shift bio-based construction from being perceived as experimental to becoming a repeatable, financeable, and scalable approach.

While much of the policy and market leadership on bio based materials has emerged from Europe, significant innovation and deployment is occurring across the globe, often driven by housing demand, climate resilience, and resource availability. For example, 84 Harrington Street is a 12-storey apartment building in Cape Town, South Africa, built using hempcrete blocks [15]. Another example is the BASE Bahay social

housing developments in the Philippines, which uses cement-bamboo composite panels and bamboo wall systems [16].

France is widely recognized as a policy leader because the Réglementation Environnementale 2020 (RE2020, France’s national building code which came into effect January 2022) makes embodied carbon a regulated, mandatory performance requirement, driving demand for lower-emission materials and making embodied carbon a core design and compliance consideration.

RE2020 uses a dynamic LCA methodology, meaning emissions released earlier count more than those released later. This strongly favors low upfront carbon emissions, such as bio-based materials.

RE2020 is also designed to become progressively more stringent over time, creating a predictable trajectory that supports investment and scaling in low carbon material supply chains.

In parallel, France has mechanisms for de risking innovation through formal technical evaluation. One prominent example is CSTB’s ATEx (Appréciation Technique d’Expérimentation), a voluntary expert evaluation process that clarifies feasibility and risk for early deployments of innovative systems, supporting decision-making by project teams.

Across Northern and Western Europe, bio-based adoption has advanced through a combination of high performance building culture, strong prefabrication ecosystems, and visible large scale precedents that normalize bio-based envelopes in multi unit residential and commercial buildings.

# LA PASSERELLE | CASE STUDY

**Client:** Foundation ARALIS  
**Location:** Villeurbanne, France  
**Architect:** BFV, Commune

**Program:** Multi-Unit Residential Building  
**Bio-Materials:** Hemp Blocks  
**Area:** 31,500 square feet

The La Passerelle project in Villeurbanne, France, is a benchmark in low-carbon social housing, demonstrating how hemp-based construction can be applied at scale. Developed by the ARALIS Foundation, the project includes 92 homes, of which 26 are supported living units, combining durability, energy efficiency, and social innovation. The project is notable for using 1,588 m<sup>2</sup> of IsoHemp hemp blocks in the façade and insulation strategy as part of a broader environmental approach that also includes district heating, rooftop photovoltaics, rainwater recovery, and the reuse of structural steel in the connecting walkways. According to project sources, the hemp blocks were selected for their thermal and acoustic performance, moisture regulation, and speed of installation, while also helping the project align with RE2020 objectives.

The lead architect engaged IsoHemp early in the design process, allowing the wall system, detailing, and construction to be optimized from the beginning rather than introduced later as a material substitution. Interviews with IsoHemp also emphasized that the long-term benefits of hemp blocks extend beyond embodied carbon reduction, including operational energy savings, occupant comfort, acoustic performance, and moisture resilience.

- KEY SUCCESS FACTORS
- Early Regulatory Engagement:** Code approval was supported through the ATEx process, reducing uncertainty and encouraging innovation while maintaining technical reliability.
  - Integrated Project Collaboration:** Strong coordination between client, architects, contractor, and manufacturer enabled the use of hemp blocks beyond standard approvals.
  - Prefabricated Hemp Blocks with High Performance:** Modular IsoHemp blocks allowed rapid installation, consistent quality, and excellent environmental and indoor comfort performance.

- KEY BARRIERS ENCOUNTERED
- Specialized Installation Training:** Construction teams required targeted guidance for proper hemp-block installation.
  - Market Familiarity Gap:** Limited experience with bio-based building systems created a learning curve for the project team.
  - Regulatory and Perception Risks:** Non-traditional materials required early engagement with authorities to ensure acceptance.



Building Exterior | IsoHemp



Hemp Blocks Staging | IsoHemp

# HYLLIE HIGH-RISE APARTMENTS | CASE STUDY

**Client:** ETC Bygg AB  
**Location:** Malmo, Sweden  
**Architect:** Daniel Fagerberg, Kaminsky

**Program:** Multi-Unit Residential Building  
**Bio-Materials:** Prefabricated Straw Panels, Mass Timber  
**Area:** ~ 50,000 square feet

The Hyllie high-rise apartments in Malmo, Sweden, represent a landmark in bio-based construction, demonstrating that straw-insulated systems can be scaled to multi-storey residential buildings. Developed by ETC Bygg, the project consists of a 12-storey residential building with 65 apartments that combines a timber structure with prefabricated straw wall panels by EcoCocon for the external envelope, designed to meet Passive House energy performance standards. The building incorporates a CLT core and features geothermal heat pumps, and solar panel balconies, contributing to both structural performance and on-site renewable energy generation. The building is fully sprinklered, supporting compliance with fire safety requirements at this scale. The EcoCocon panels used are fire-rated, demonstrating that straw-based systems can meet stringent regulatory expectations for multi-storey buildings. The project is also notable for its low embodied carbon, with a reported carbon intensity of approximately 130 kgCO<sub>2</sub>e/m<sup>2</sup>.

- KEY SUCCESS FACTORS
- Prefabricated Straw Panels with High Performance:** The use of factory-made straw panels enabled quality, precision, and performance, helping the

envelope achieve the airtightness and thermal efficiency required in a high-performance building. In addition, the straw panels carry some structural load, expanding their role beyond insulation and contributing to overall system efficiency.

- Use of Straw at a Large Scale:** Hyllie is widely cited as one of the tallest straw-and-timber buildings globally, showing that bio-based materials can be applied beyond small-scale construction. This visibility helps challenge prevailing assumptions about limitations of agricultural materials in large urban buildings.

- KEY BARRIERS ADDRESSED
- Sound Transmission and Fire Ratings:** Sound and fire concerns were mitigated through the use of layered assemblies, CLT slabs with appropriate fire ratings, and sprinkler systems in accordance with regulatory requirements.
  - High First Costs:** Construction costs are currently approximately 20% higher than traditional rental housing due to the "first-of-its-kind" nature of the project; however, cost reductions are anticipated as standardization and repetition increase.



Prefab Construction | ETC Bygg



Construction Progress | ETC Bygg

# MECHANISMS TO ACCELERATE ADOPTION IN CANADA

With abundant bio-based feedstocks and goals to accelerate decarbonization in construction, Canada is well positioned to scale the use of bio based materials.

Taken together, the barriers identified in this report point to a need for coordinated action that reduces technical uncertainty, streamlines approvals, strengthens supply chains, and builds market confidence. The mechanisms that follow are designed to work as a complementary package: they focus on building shared evidence and guidance, enabling more repeatable and industrialized delivery models, and creating credible pathways for assessment, approval, and learning-by-doing. Collectively, the intent is to accelerate the transition of bio-based materials from one-off applications to mainstream use in larger Canadian buildings.

These mechanisms should also be advanced in parallel with ongoing efforts to integrate embodied carbon considerations into the National Model Codes. As Canada moves toward regulating and reporting embodied emissions [19], there will be increased demand for materials and systems that can demonstrate low or negative carbon impacts. Aligning the following proposed mechanisms with code and standards modernization efforts can help ensure that bio-based materials are technically viable within emerging regulatory frameworks, ultimately accelerating market uptake and investment.

## 1. SUPPORT BIO-BASED MATERIAL ASSEMBLY TESTING AND ESTABLISH CLEAR COMPLIANCE PATHWAYS

A key barrier to scaling bio-based materials in Canada is the lack of standardized, tested wall assemblies and clear compliance pathways for novel building systems. While the testing and evaluation requirements needed to demonstrate compliance generally exist, they are often distributed across multiple standards, code provisions, and approval processes. In addition, because building codes assess full assembly performance, project teams looking to integrate bio-based materials often need

to pursue alternative solutions to demonstrate compliance, adding time, cost, and risk. This challenge is compounded by the fact that smaller bio-based manufacturers typically lack the resources to conduct expensive performance testing, unlike larger conventional suppliers with dedicated testing programs. As a result, there are relatively few pre-approved assemblies available. This is further complicated by variability in material performance between different manufacturers, where similar bio-based products may not behave consistently in assembly testing without shared standards or specification frameworks.

One mechanism to address this is to invest in coordinated assembly-level testing, establish a shared library of tested systems, and create clearer guidance on the performance evidence and approvals required for different types of bio-based assemblies. This library would compile verified data on fire resistance, thermal and moisture performance, and code compliance pathways. These efforts would reduce duplication across projects and create clearer, more consistent pathways for specification. This initiative would require collaboration between manufacturers, design firms, testing bodies, and government agencies. Support for this testing can take different forms, including:

- Develop guidance outlining the testing, documentation, and performance requirements for common bio-based assemblies to improve consistency and reduce reliance on project-specific alternative solutions.
- Creation of a fund for testing to be conducted by manufacturers, backed by financial investments by government and investors
- Conducting industry engagement to define what testing is needed to support uptake based on constructor, designer, and building owner needs in addition to code requirements



## 1. TESTING AND CLEAR COMPLIANCE PATHWAYS

- Industry-based organizations or a government agency establishing the shared library of tested systems

This approach would deliver several benefits that support market scaling:

- **Clearer compliance pathways:** Reduces uncertainty for manufacturers, designers, regulators, and insurers.
- **Reduced project risk:** access to verified assemblies increases confidence for designers and regulators
- **Lower costs for manufacturers:** shared testing and funding reduces financial barriers to enter the market
- **Industry-wide learning:** shared data reduces duplication and accelerates knowledge transfer

## 2. SUPPORT ADVANCEMENT OF PREFABRICATED, PANELIZED BIO BASED SYSTEMS

A key barrier to scaling bio-based materials is integration into standard construction workflows, particularly in larger and more complex buildings.

Prefabricated exterior wall assemblies, such as the EcoCocon prefabricated straw wall panels, can support greater consistency, quality assurance, and repeatability. Because these systems are standardized, they are also easier to test, certify, and approve from a code perspective, reducing reliance on project-by-project alternative solutions. Prefabrication leverages established technologies and construction practices and does not require a complete shift in how buildings are designed or delivered. For trades, installation can be simplified, reducing the need for specialized training and can support shorter construction timelines.

Panelized systems are also particularly well suited for multi-storey and large buildings, where consistency and speed are important. Their modular nature supports scalability, making them a strong



## 2. ADVANCEMENT OF PREFABRICATED PANELIZED SYSTEMS



## 3. PILOT PROJECTS FOR LARGE BUILDINGS

fit for rapid housing initiatives, where there is a need to deliver high volumes of housing quickly while maintaining performance and quality.

A coordinated approach to advancing panelized systems requires participation across the construction and manufacturing, including:

- **Manufacturers and Prefabricators:** to develop, standardize, and scale panelized bio-based systems
- **Developers and Public Sector Owners:** to drive demand through early adoption and procurement strategies
- **Design Teams and contractors:** to integrate prefabricated systems early in the design process and adapt delivery models
- **Regulators and Code Consultants:** to support consistent approval pathways for standardized assemblies
- **Industry Organizations:** such as CSBA to convene stakeholders and align market efforts

Advancing panelized bio-based systems would result in several benefits that support broader market adoption:

- **Improved Scalability:** standardized systems are replicable across projects and building types
- **Reduced Project Risk:** consistent performance and tested assemblies increase confidence among stakeholders
- **Faster Delivery:** offsite fabrication shortens construction timelines and supports rapid housing initiatives

## 3. ADVANCE PILOT PROJECTS FOR LARGE BUILDINGS THROUGH AN EARLY ADOPTERS COHORT

A key barrier to scaling bio-based materials is the lack of Canadian precedent in larger buildings, which reinforces risk aversion among developers, insurers, and regulators. While many bio-based systems are technically viable, their application



## 4. DEVELOP A CENTRE OF EXCELLENCE

in Part 3 buildings remains limited in Canada. Without visible, successful examples at this scale, stakeholders are often hesitant to move forward, particularly when combined with code complexity and supply chain uncertainty.

One way to address this is through strategic pilot projects in larger buildings that demonstrate the feasibility of bio-based materials in real world conditions. These projects would act as proof, showcasing performance across key metrics such as fire safety, durability, constructability, and cost.

Advancing this approach will require targeted funding, committed project partners, and a willingness to take on measured risk, particularly from public sector leaders. As such, an early adopters cohort and incentive program is recommended to support first-of-their-kind projects, similar to programs such as the Commercial Building Incentive Program (CBIP).

To be successful, the cohort will need to identify the performance metrics that these case studies will need to measure in order to demonstrate the value, benefits, and viability of bio-based materials.

Pilot projects can deliver several benefits that extend beyond individual buildings:

- **Reduced Perceived Risk:** demonstrated performance builds confidence among industry stakeholders
- **Replicable Models:** successful pilots create templates for future projects and specifications
- **Faster Approvals:** documented precedents help streamline code and insurance reviews
- **Market Signals:** visible projects increase demand and encourage investment in supply chains
- **Innovation Testing:** pilots provide a platform to refine prefabrication, procurement, and integrated design approaches

**4. DEVELOP A CENTER OF EXCELLENCE TO DELIVER PEER ASSESSMENT OF INNOVATIVE BUILDING MATERIALS AND CURATE A SHARED PLATFORM OF SOLUTIONS**

Bio-based building products often face uncertainty in code compliance, insurance acceptance, and interpretation of test results in a Canadian context, leading to duplicated due diligence across projects, higher soft costs, longer approvals, and conservative decision making. As noted, France’s CSTB ATEx program offers a peer-assessment model that supports new and innovative construction techniques outside standard regulations.

We propose creating a Canadian Center of Excellence (CoE) for structured peer assessment of applying bio-based building materials, modeled after ATEx. The CoE would bring together independent experts to evaluate products or assemblies, outline risks and mitigation, and deliver clear documentation for use by owners, designers, code consultants, AHJs, and insurers. Outputs, such as technical memos and recommended usage conditions, would be published in a public platform to minimize repeated work. The proposed CoE would not serve as a code authority, nor would it replace required material testing, certification, or formal approval processes. It would function as a complementary peer assessment layer that supports existing regulatory mechanisms.

In addition to its peer-assessment function, the proposed Center of Excellence would serve as a central, practitioner-oriented knowledge platform for bio-based construction in Canada. Building on international precedents such as OpenDetail and the ACAN Natural Materials Detail Library, the CoE would curate and maintain a shared repository of Canadian-relevant material solutions, tested assemblies, and supporting documentation. This would include evidence packages (e.g., fire-resistance test data, CCMC evaluations, and installation guidance), plain-language code pathway summaries and templates to support alternative-

solution submissions, and cold-climate enclosure guidance tailored to bio-based systems. The platform would also compile a directory of case studies documenting approvals, procurement strategies, cost implications, and lessons learned from built projects. By consolidating this information within a single, trusted source governed by a technical advisory group, the CoE would reduce duplicated effort across project teams, improve consistency in regulatory and insurance review, and accelerate the transition from project-specific innovation to repeatable, mainstream application.

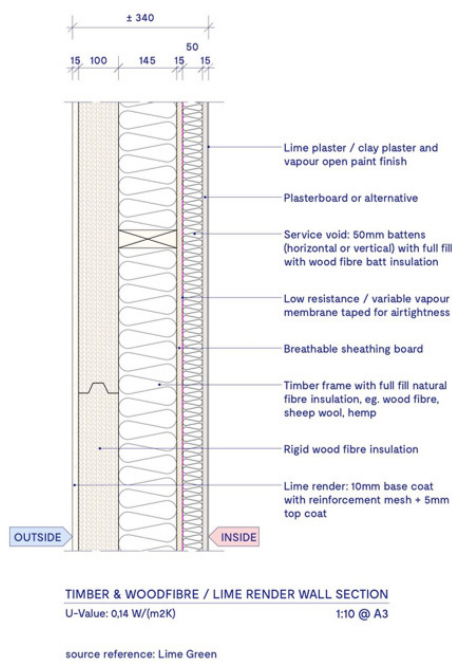
A credible CoE requires participation from a host and governance lead, technical reviewers, and representation from regulatory and risk stakeholders.

A Canadian CoE would result in numerous benefits accelerating bio-based building materials:

- **De-risking for project teams:** provides an independent, structured technical basis to

support specification, procurement, and alternative solution submissions.

- **Reduced duplication:** a registry of assessments and evidence checklists reduces repetitive due diligence on each project, lowering soft costs and timelines.
- **Improved insurer/warranty confidence:** consistent documentation of risk controls, detailing requirements, and quality assurance plans can shorten insurance review cycles.
- **Shared learning:** Feedback from early deployments can be captured and translated into guidance for subsequent projects, accelerating market familiarity and workforce capability.
- **Supports code and standards evolution:** aggregated insights on recurring evidence gaps can inform priorities for standards development, CCMC evaluations, and future code updates.



# CONCLUSION

This white paper was developed to advance industry understanding and uptake of carbon-storing and bio-based materials within Canada’s built environment. It responds to a clear and growing need: as operational emissions decline through electrification and efficiency advancements, embodied carbon from materials is becoming an increasingly significant driver of the building sector’s climate impact. Bio-based materials offer a high-impact opportunity to reduce embodied emissions while storing biogenic carbon in long-lived building assets.

Canada is well positioned to scale bio-based materials at meaningful levels. The country has abundant biomass feedstocks, established expertise in wood construction, and increasing momentum around low-carbon procurement and “Buy Canadian” supply-chain resilience. Within this context, the report identifies wood-based products, straw-based systems, and hemp-based materials as high-potential candidates for near- to medium-term scale-up. These materials demonstrate strong carbon reduction potential, increasing technical maturity, and alignment with Canadian forestry and agricultural sectors. They also align well to high-impact applications, such as building envelope assemblies, where material volumes are large and where design decisions have influence on both operational and embodied carbon impacts.

At the same time, our review reinforces that scaling is constrained by system readiness rather than technical performance. Across stakeholder input and case study review, the barriers identified are consistent: limited standardized, assembly-level performance evidence; unclear or burdensome code compliance pathways; insurer and warranty uncertainty; immature supply chains and regional manufacturing capacity; and limited Canadian precedent at scale. These barriers create a reinforcing cycle in which early adopters bear disproportionate cost and risk, while mainstream project teams default to conventional materials even when bio-based options may be technically viable.

Global examples demonstrate that these constraints can be overcome when enabling conditions are deliberately built. In leading jurisdictions, bio-based adoption is strongest where lifecycle carbon requirements create market pull, where credible evaluation and approval pathways reduce uncertainty, and where product standardization and industrialized delivery models support repeatability.

The mechanisms proposed in this report are intended to address these barriers. Together, they form a practical package that reduces friction for project teams and accelerates learning across the market. Strengthening coordinated testing and assembly libraries addresses the core evidence gap that drives conservative decisions. Advancing prefabricated, panelized bio-based systems supports consistency, quality assurance, and scalable delivery within familiar construction workflows. Establishing a Canadian peer-assessment function can reduce repeated due diligence and improve confidence among approval authorities and insurers, while a shared Canadian platform of bio-based solutions can translate emerging knowledge into repeatable practice. Finally, strategic pilot projects in large buildings can generate the visible precedents required to normalize bio-based solutions and shorten future approval timelines.

Scaling bio-based materials in Canadian construction provides economic opportunity beyond the strong climate impact. By leveraging Canada’s natural resource advantages, the industry can support near-term embodied carbon reductions, strengthen domestic supply chains, and help position Canada as a global leader in low-carbon, carbon-storing construction.



Wood Cladding at the Edmonton Valley Zoo | DIALOG



Rammed Earth at the Edmonton Valley Zoo | DIALOG

# FURTHER READING

Discussion and Definitions: Bio Based Materials in Construction, Bio-Based Materials Collective

Building a Low Carbon Future: Exploring Feedstocks & Products for Canada's Construction Sector, Natural Resources Canada

Advanced Forest Based Biomaterials for the Building Industry, Opportunity Roadmap for Ontario, Centre for Research & Innovation in the Bio-Economy

Building Materials and the Change: Constructing a New Future, UN Environment Programme

Carbon Storing Materials: Summary Report, Carbon Leadership Forum

NOW The Upfront Carbon Façade Materials A Guide, SvN

Bio Based & Natural Materials: Context, Applications, and State of the Industry, Perkins&Will

Bio- & Mineral-Based Materials Primer, Bio-Based Materials Collective, MASS, Perkins&Will

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